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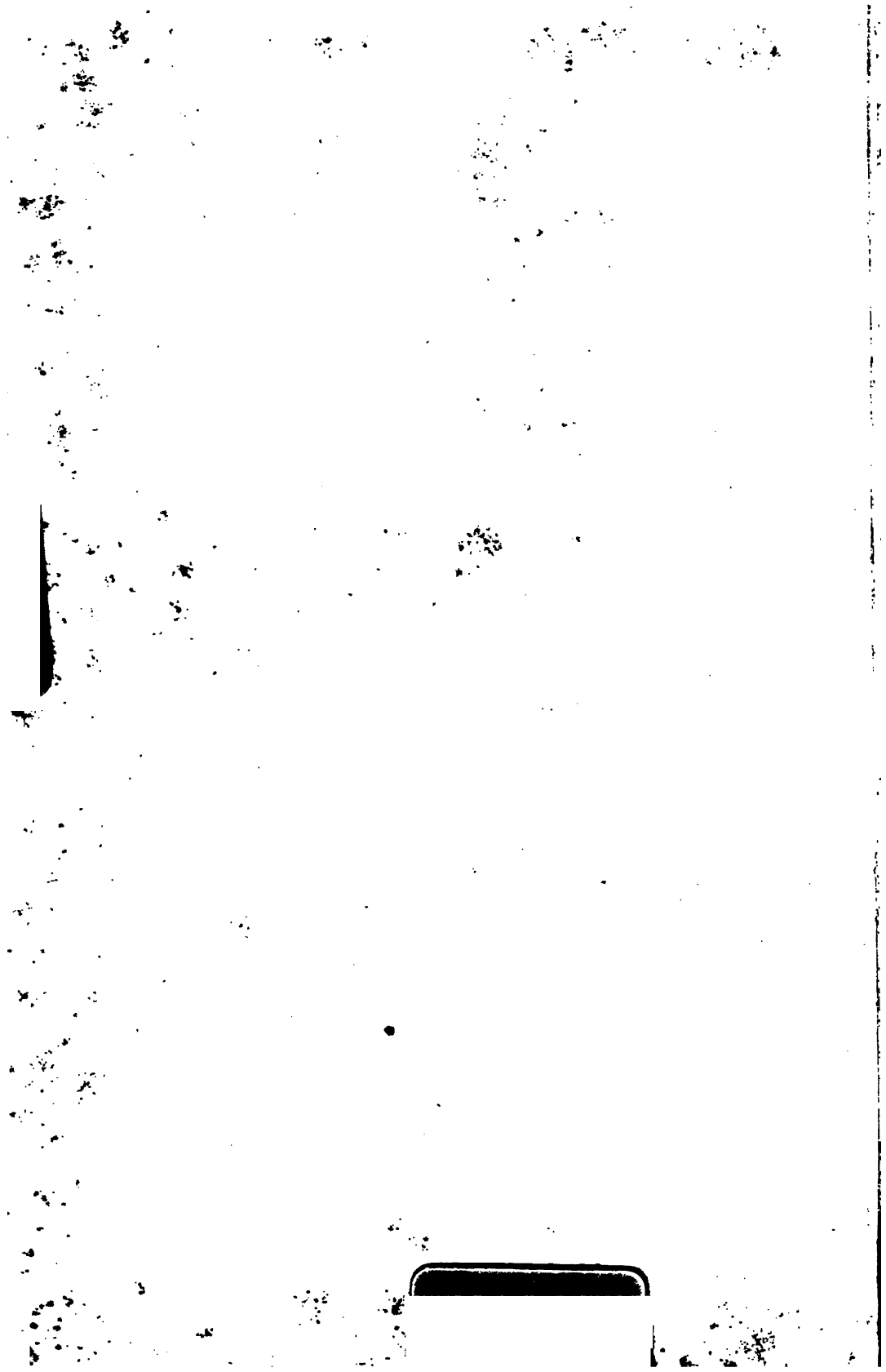
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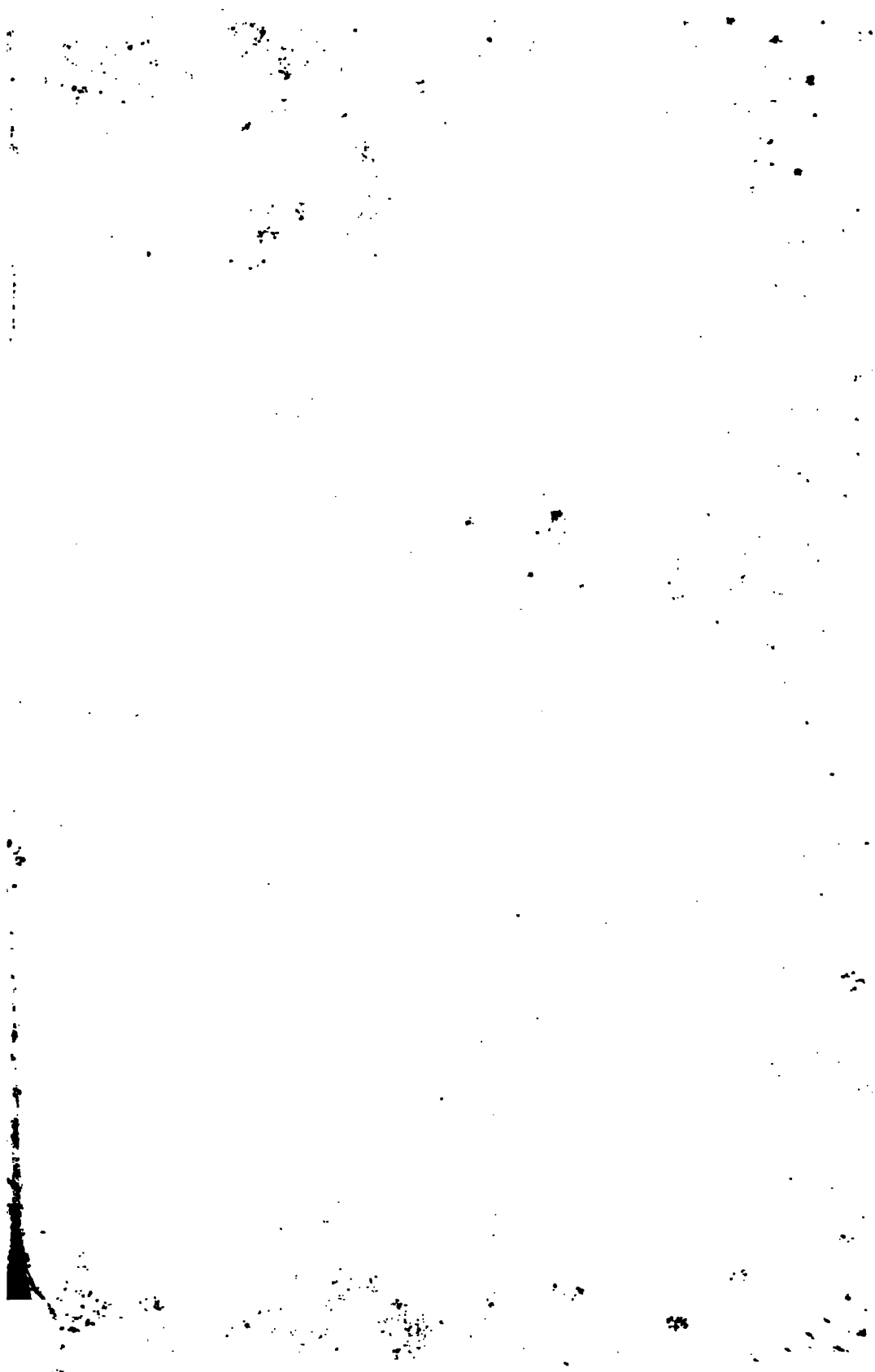
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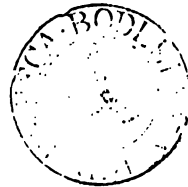




REPORT ON INSECTS

DESTRUCTIVE TO WOODS & FORESTS.

By MR. R. THOMPSON,
Assistant Conservator, Gurhwal Forests.



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ERRATA.

For "Plate VIII." read "Plate IX.," and for "Plate IX." read "Plate VIII.," in Report.

REPORT ON INSECTS DESTRUCTIVE TO WOODS AND FORESTS.

By MR. R. THOMPSON,
Assistant Conservator, Gurhwal Forests.

No. 80.

To the Commissioner of Kumaon.

Dated the 17th August, 1867.

SIR,

I beg to forward a Report on Insects Destructive to Woods and Forests, called for in your letter No. 353, dated the 26th November, 1866.

2. In compliance with the views laid down in Inspector-General of Forest's Circular No. 1, dated the 23rd June, 1866, I submitted in August last year a brief report, giving general characters only of such insects as were known to me to derive their subsistence from the ligneous portions of vegetables, and also such as only availed themselves of timber for purposes of rearing their young.

3. I was not at that time in a position to submit more detailed information, as my collection of insects was all gone, and I had no notes from which to compile a report. Besides, to make it really useful, information of the sort required could only have been obtained after much observation and investigation had been undertaken.

4. In reply to my report of last year, the Commissioner communicated to me a desire that I should undertake the work of collecting and reporting on such insects during the period I am usually engaged in the forests, and submit the same after return to head-quarters.

5. With what effect I have carried out this desire will be best learnt by a perusal of the present report.

6. From November till June, I had thus eight clear months before me for the work of collecting and noting the habits of the insects in their various phases of existence ;

also of taking sketches of their ravages, and experimenting and gathering information on the modes in adoption for their destruction.

7. The larger and more typical insects I have figured with colored photographs in their three states of existence—viz., the larva, pupa, and imago, or perfect state. These were all obtained and authenticated by myself from logs and living trees infected by them, which were all noted and visited at intervals; so that having procured some of the larvæ which I preserved in spirits of wine, I could return at a future time and find them in the *pupa* state. Later in May and June, I procured the perfected insects before they had come out of the timbers and flown.

8. To enable the present report being as perfect as possible, I have drawn it up into two parts—viz., Part I., an introductory notice on the natural history of insects; their economy, and characteristics peculiar to them, as animals distinct from those of a higher class of organization; and Part II., their ravages, with special reference on the timbers and trees observed in the Kumaon and Gurhwal Forests, with notices of the usual methods adopted in compassing their destruction.

9. In such a form as this, I trust the report will be found really useful, as conveying a somewhat accurate general knowledge of the subject, without much dry technical detail which would be unsuited to the present work.

10. I have seen it recorded in an eminently scientific work, with as much truth as brevity, that the profits we derive from the works of creation will be in proportion to the accuracy of our knowledge of them and their properties. This should be the motto of every Forest Officer; and it is with the trust that a subject so intimately connected with the profession should meet with attention at the hands of our foresters that has induced the idea of giving in one report enough to place it in an interesting light; that by colored figures and sketches the attention might be arrested, and some awakened interest be the result.

11. Forest conservancy has for its aim and scope the protection, care, and cultivation of trees and other forest plants for the valuable products which they yield us in their timbers, resins, gums, fibres, fruits, &c. ; and that these products should be economized and applied to legitimate purposes seem to follow as natural conclusions.

12. Admitting, then, these to be true inferences, we have, at one view, the necessity forced upon us, as conservators and economists of our forests, to preserve and apply those products which they yield to their rightful uses ; and as the prevalence of insects is injurious to such stock, it becomes our bounden duty to acquire that knowledge which will enable us not only to diminish that prevalence, but also rescue and preserve from their attacks such yields.

13. For an exhaustive introduction to Entomology, Dr. Burmeister's is the best that has fallen into my hands ; next to that is an older though more classical work, viz., Kirby and Spence's Introduction.

These and Baron Cuvier's classification in his new edition comprise the works which I have been guided by in my study of that interesting science.

PART I.—INTRODUCTION.

14. Insects are articulated invertebrated animals, possessing a heart, breathing not by lungs, but through spiracles placed in a series of rows along the abdomen. They possess a small brain, and have instead a small knotty process resembling the spinal chord.

Four wings usually ; six legs ; two antennæ, and four palpi or feelers, which form a part of their feeding apparatus.

They undergo various changes ; are first produced from eggs into *larvæ* ; from thence into *pupæ*, and lastly into the perfect insect or *imago*. These changes are called their metamorphoses.

15. Their eggs are of various forms and shapes, sculptured and figured in some, rounded in others, but the generality of them are oval. They are also variously colored, but the prin-

cipal colors and which preponderate are white, yellow, black, and green.

They are deposited by the perfect or parent insect in localities suitable for their reception and future development. For this purpose the mother insect selects the object or substance that instinct has directed her as being the best adapted to serve those ends. Water for a few; the soil of the earth for a great many; but the vegetable kingdom for vastly the greatest number, serve insects as suitable habitations for rearing their young.

16. The *larva* is that state in which the greatest amount of food is consumed. It is the period occupied solely for nourishing up the body and bringing it to that development which is to provide the future insect with organs suitable for a different sphere of existence.

The *larva* from being the size of a pin's head is fed and nourished by the substance upon which it is found. Those living in the interior of timber or on vegetables, or other hard substances requiring manducation, are furnished with a pair of powerful horny *mandibles* or jaws; another and less powerful pair of masticatory jaws or *maxillæ*. Those which chiefly inhabit water are of carnivorous or raptorious habits, and prey upon insects smaller and softer than themselves, are furnished similarly with jaws, but adapted for seizing and destroying their prey. Those that inhabit the soil are either vegetable feeders, and conform in their structure to that section, or are carnivorous, and are hence provided with the means of obtaining their food similar to the water-inhabiting carnivora. A few have suctorial mouths, but these feed upon the juices of animal and vegetable substances, especially when such are in a state of decomposition.

17. *Larvæ* are usually provided with six legs; in many these organs are not visible, or are wholly wanting.

Their body is divided into thirteen segments or rings, the first three of which are occupied by the head; the legs are placed on the fourth, fifth, and sixth segments;—these are true legs. A few caterpillars, the name generally given to the

larvæ of butterflies and moths, have also in addition to the true legs what are called pro-legs. These are sometimes placed on the inferior extremity of the body ; in some they occupy many segments and are represented as horny tubercles, and armed with apparatus which enables the possessor to walk on or cling to polished or smooth surfaces. Such *larvæ* generally feed on the leaves of vegetables.

18. The period of existence in this state varies in different orders. In some it is only for a brief time, in others a month or fortnight, in more again several months, and in the larger coleoptera from three to four years.

During the whole of this period, these creatures are solely occupied in eating, and their voracity is immense, commensurate with their growth. Having attained their full size, they make provision for entering into the third or *pupa state*.

19. Insects in the majority of instances remain quiescent in this stage. They have lost the power of locomotion, and the appetite for food is changed into the lethargy of sleep. They construct various styles of habitations for their residence while in this state.

The round, oval, or globose, are composed of materials resembling silk, tissue, or papery substances ; some earth ; a few of a substance resembling lime in appearance ; and some of fragments of wood or small sticks glued together. These are all called cocoons, and are the *pupa cases*.

Many also retire into the earth for this metamorphosis, where they make for themselves chambers ; others into timber, where they hollow out tunnels ; and others having made themselves cases from substances produced from their own bodies and exuviated skins and hairs attach them to various upright objects, of which trees furnish universal example.

A few in the *pupa state* retain the power of locomotion and capacity for feeding.

20. From this state, after due interval, varied in the different orders, the insect bursts forth the *imago* or perfect animal. In this state it has acquired the organs of locomotion, such as a pair or two of wings, two antennæ, which

serve the purpose of feelers, and the organs which convey through vibrations of the air the sense of sound. Two compound eyes and several ocelli or spurious eyes; these are placed on the top or vertex of the head.

All perfect insects have the compound eyes, but not all have ocelli.

Three pairs of legs, articulated with the extremities of the tarsi with hooks which enable the insect to cling on to rough surfaces.

Two pairs of jaws,—the *mandibles* or front pair, for biting, the *maxillæ* or under pair for the mastication of food; four feelers or *palpi* forming a part of the oral apparatus.

The body of perfect insects is divided into three distinct parts called severally the head, thorax, and abdomen. It is from these articulations and divisions that the term *insect* has been applied to these animals,—a division or cutting into parts of the body.

Having acquired the powers of locomotion in a more than twofold degree, for it can both walk and fly rapidly, the insect now has not the same appetite as when in the *larva* state—nor has it the power of enjoying that food which served to bring it to its present perfection. Its structural organisation has undergone material change.

Its stomach, from being a capacious sack for the reception of crude matter, is now elaborated into one so delicately fine that a minute drop of nectar from any flower suffices its wants. Such indeed is the case with all butterflies and moths, but not with all beetles. Grasshoppers and dragon flies form a general exception, for they are as voracious and as capable of devouring much food in their perfect state as they were when in the larval condition.

21. The perfect or *imago* state is the period when it can be said that insects truly enjoy themselves. They are gifted with senses such as love, touch, taste, smell, sight, hearing, and the commanding and governing senses, all of which they display in their external relations to the world around them in a most remarkable degree.

It is in the perfect state that the two sexes meet, and the propagation of their kind is effected.

After impregnating, the males usually die. The females live a short space longer, until the object of their existence is also attained, namely, the laying of eggs, which contain in embryo future generations of their species. Their fecundity is usually very great.

22. Insects in their relation to plants appear to render a twofold service in the great economy of nature. They appear to be created for the destruction of dead vegetable matter, and also to keep under superfluous growth. This is evident when it is considered that whole orders of insects subsist, from the time they are brought into existence till their death, on leaves, flowers, fruits, seeds, soft stems, and the juices of plants. Those that live in the interior of the trunks of trees do not destroy them immediately, but by boring into their solid parts, they render them fit for the speedy consummation of that decay which is set as an inevitable decree against all organized things and beings.

The other object they serve is by dissemination of the fructifying pollen from trees remote from their own species, and which have not the sexual organs produced together in their flowers individually ; or the male anthers of such being so placed on the flowers that, without some such assistance as is rendered by insects, the female organs of such flowers could not be impregnated with the fructifying pollen of the male organs. Bees, butterflies, a few beetles, and dipterous flies are chief agencies employed in this work ;—and here we have a display of that design which the Creator of All has executed, of the balance being kept between creatures and things of His will, so that the one does not preponderate over the other without rendering a due return for it in some other way.

Having briefly remarked, in a previous paragraph, on the enormous prolificacy of insects, let us glance at the means which are levelled at keeping those which immediately affect forests and their products under controlable limits.

Amongst birds, the forester's friends, particularly may be reckoned the Wood-peckers, *Picidæ*.—Doctor Jerdon in his valuable work on Indian Ornithology has enumerated no less than thirty-three species of Wood-peckers found in India. Of this number, the forests of these provinces possess, in more or less abundance in the number of individuals of each species, twenty-one varieties, all of them being pre-eminently larvæ feeders.

The *Chrysocolaptes sultaneus* and *Chrysonotus Shorei*, both of which are common and numerous in individuals, may always be met with in our forests, and heard tapping both the living and dead trees in their search for the larvæ of beetles.

Having found the situation of the grub, the Wood-pecker will forthwith dig at the place with its strong cuneate bill, rip out the bark, and expose the helpless victim, which is forthwith seized and swallowed; or if the grub has escaped into the interior of the timber, the bird has still the power to pursue it, digging into the wood with its strong bill, which it can with facility even in the hardest timber.

A Wood-pecker that I once watched at work—it was a beautiful, though common species, the golden back, *Brachypternus aurantius*,—appeared busy for a long time in effecting a breach into the retreat of the larva, which was that of a *Cerambyx vatica* or Sal grub; after much digging and frequent pauses when the bird was apparently listening to the movements of the worm, it at last managed to secure its victim.

There can be no denying that these birds are of eminent usefulness to the forests by destroying no inconsiderable number of the eggs and larvæ of beetles.

The *Sittinæ* or *Nuthatches* are represented in the forests of our provinces by four species: *Certhias* or true creepers, and *Parrinæ* or Tit-mice are all largely represented, so that we have a considerable natural army of the feathered race, our allies in keeping down a pest, which, were it not for these, whose sole occupation is to hunt for the eggs and larvæ of insects comprising their natural food, man would stand but a poor

chance of accomplishing the same, unaided, by his own resources.*

PART II.—THE RAVAGES OF INSECTS, &c.

23. Having briefly generalized most of all that is written and recorded of insects, their habits, and the peculiar parts assigned to them in the great work of nature, I will proceed to record practical observations of their ravages and the modes usually adopted to keep these within the bounds of limit. This part of the report will therefore be confined to personal experiences obtained during the last eight months, when my earnest attention was devoted to the subject, being directed to it by Colonel H. Ramsay in a letter No. 353, dated 26th November, 1866.

I will methodize these observations by classifying the insects according to the systematic arrangements of Entomologists, giving the characters of their orders, &c., and then proceeding to describe the ravages in due course as committed by individuals of the various groups.

This arrangement will much simplify the subject, as it will give, at the commencement of each, notice of the natural history of the group, and immediately the details of the ravages recorded and means adopted to prevent them, following:—

* Insects comprise the natural food of a large number of other birds besides those enumerated above. The hard-bodied beetles and other coleoptera chiefly are eagerly seized while on the wing by birds—such as Shrikes, Drongos, Crows, Rollers, Bee-Eaters, Thrushes, &c.

These, then, are their enemies, and our friends, during the period when such insects are in their perfect or imago state. The wood-peckers and others, before enumerated, are peculiarly active in the destruction of insect life during its stages of progressive or imperfect development.

Many Bats (Cheiroptera), Carnaria (Insectivora), and Civits (Viverra) are insect feeders, and render valuable service to mankind by keeping down insects.

The Acari and Ichneumonidæ, among insects, are destructive to caterpillars and grubs. Some of the Ichneumons render effective service by the destruction of the larvæ of many species of gall flies. In future reports I will enlarge on this subject more fully.

The insects which are noticed in this report, and which are usually destructive to living and dead vegetable substances, may be stated as belonging to the following natural orders :—

Order,—Coleoptera (Beetles).

Family,	Serriornes.
	Buprestis.
Family,	Lamellicornes.
	Euchirus.
	Lucanus.
Family,	Rhynchophora (Weevils).
	Bruchus.
	Curculio.
	Rhyncœnus.
	Calandra.
Family,	Xylophagi (wood-eaters).
	Scolytus.
	Hylesinus.
	Tomicus.
	Bostrichus.
Family,	Longicornes (Capricorn Beetles).
	Prionus.
	Cerambyx.
	Monochamus.
	Lamia.
	Saperda.
	Leptura.

Order,—Hemiptera-(Bugs).

Family,	Aphidii (Plant Lice).
	Aphis.
Family,	Gall-insecta.
	Coccus.

Order,—Neuroptera (Lace-wings).

Family,	Planipennes.
	Termes (white-ants).

Order,—Hymenoptera.

Family, Scurifera.

Tenthredo.

Family, Cynips.

Family, Mellifera (Bees).

Xylocopa.

Baron Cuvier's New Edition of 1854.

25.—Ravages of Coleopterous (Beetles) Insects.

The term coleoptera is compounded of two Greek words, implying sheath-winged, or wings covered with a horny substance which serve to protect the soft membranous true wings.

The sheath is never employed as an organ of flight, but is carried by the insect obliquely erect, and thus allowing free action to the true wings during aerial locomotion. Hence coleoptera may be generally known by these horny wing-protectors or sheaths.

Their eggs, which are never more in number than 40 or 50, are deposited in the bark of living or dead timber, in the fermented sap-wood of felled logs, and in decayed or rotten vegetable matter. The females, which are usually the larger of the two sexes, accomplish this by means of a long horny ovipositor or instrument for the penetrating and conveying through a tube or duct the eggs to the place destined to receive them.

The *larvæ* or grubs are usually long, fat, yellowish-looking animals, armed with formidable jaws for the manducation of the solid portions of wood upon which they feed.

Some, as in the Lucanidæ, are provided with six legs, but the majority of the others have only the rudiments of legs, or none visible at all.

The Weevils excepted, which have the legs small and which enable them to crawl with some motion.

The *larvæ* of the Lamellicornes have the extremity of the body curved towards the breast, so that when placed upon a flat surface they cannot creep, but lie on their side. They accomplish locomotion, however, in such cases by crawling

on their side with barely the anterior portion of their body carried horizontally.

The *larvæ* of Longicorns are only able to effect locomotion when in the tunnels bored by them in wood. The motion is effected by an alternate contraction and elongation of the body.

Their *pupæ* are always enclosed in a thin substance, which covers all parts as with a case, and all their organs are visible through it; a few enclose themselves in cocoons formed of bits of sticks glued together with a substance excreted by the *larvæ*, others close up the orifices of their tunnels with gnawed fragments of timber lined with a white lime-looking substance, and others again prepare egg-shaped *cocoons*, which they place between the wood and the bark made of the same white limy substance.

When the perfect insect appears, it gnaws its way through the channels made by its *larva*. In the case of Bostrichidæ they gnaw independently a channel to the nearest point out.

26.—The *Buprestidæ*.

These are beetles usually of brilliant colors, and are found underneath the bark of trees, where their *larvæ* live on it and the sap-wood. A very pretty *Buprestis* (see Plate VIII., F. 18 and 19) was found by me in felled logs of Sal in the Kotree Dhoon.

The *larva*, after acquiring maturity, bores into the timber to the depth of from two to three inches, making a diamond-shaped orifice. It then undergoes its metamorphosis in the *pupa* state. These beetles sometimes infect in vast numbers, rendering the timber unfit for use afterwards.

Another and magnificent *Buprestis* (see Plate VIII., F. 25) was found by me in the dead timber of a living Khair tree (*Acacia catechu*); the death of the limb was due to the *larva* of the *Buprestis*.

A very large *larva* of a *Buprestis* was found in a thick living trunk of mango. The grub had evidently lived in it for two or more years—a habit not uncommon in a section



of the family Buprestidæ. The larva procured in this instance by me was first discovered from the particles of saw-dust-looking excrement it had ejected through an orifice. It is not common for the larva of Buprestidæ to thus disclose their retreats, as they, in common with the Bostrichidæ, cause the excrement to cake to quite a hardness in the interior of their channels. The grub in question was nearly three and a half inches in length, of a fleshy white color, with anterior or head portion greatly dilated into a circular horny plate. The larva figured in Plate VIII., F. 24, will convey an idea in miniature of the mango grub.

A small Buprestis of a shining olive color, with yellowish white spots, is frequently found in the timber of the Cheer or *Pinus longifolia*. When numerous, its larvæ render the timber quite unfit for beams, as their borings are frequently to a great depth, and it requires some practice to detect the solid from the mere fragmentary particles of wood which the larvæ leave along the course of their channels.

The mode usually adopted to protect felled timber from the attacks of these insects is to cause the bark to be removed as soon after the log is felled as possible.

The *rationale* of this is that it is only in the bark the female insect can deposit her eggs, and the sap-wood and newly-formed bark afford the larva nourishment.

Exposure to dry hot air or sun, or immersion in water for two or three days, will destroy the grubs.

The Buprestidæ are a very interesting family of timber destroying beetles ; many, I dare say, will be found inhabiting the living limbs of healthy trees as in the case of the grub discovered in the mango (*Mangifera Indica*). Further research will be made into their habits and economy : *see illustration of ravages of Buprestidæ*.

27. Of the Lamellicorn Beetles, I have figured two specimens, belonging respectively to the Genera *Euchirus* and *Lucanus*,—see Plate I., figure 1, for the former, and Plate II. for the latter. Of the *Euchirus* figured, I am not able to report from personal experience of its habits, but I have been

informed on good authority that its habits are similar to its congener, the stag beetle or *Lucanus Cervus*. The present specimen of the *Euchirus* was obtained at Nynee Tal when it had issued out of an oak stem.

The stag beetles are both numerous and common in individuals, and are, of the whole order of wood beetles, the most destructive to living trees. Some idea may be formed of the ravages of these insects when it is stated that the larvæ live from three to four years in that state in the interior of the trunks of oaks, and that barely one in ten of the trees to be met with about Nynee Tal does not bear the marks of their

* See Plate III. for figures of these insects. ravages. These and larvæ of *Prionus* beetles seem exclusively to attach themselves to the oak as their habitation.

They bore circular chambers, penetrating to the heart of the stem, winding into various passages both up and down the trunk. They eject the undigested particles through holes made for the purpose, forming lateral communications with the main tunnels; these particles may be observed at the roots of the trees so affected in the form of small lengthened chips.

I am not aware if anything is known with reference to destroying them whilst in the living tree; but in felled logs this is easily managed either by immersion in cold water, or, having discovered the hole, by pouring scalding water into it; no grub can, in any instance that I have known, withstand this operation.

In the family of *Lucanus*, the males are usually larger, sometimes more than double the size of their females. Their mandibles are prolonged into long horns resembling those organs in the Cervine tribe of the Ruminantia. With these armaments the males will often fight with remarkable vigor and energy in their battles for the possession of the other sex which is limited in individual proportion. Two male stags will approach, and, entwining their mandibles, will try one to lift the other off his feet; accomplishing this, the victor will march off with the defeated, carrying him clasped in his long mandibles to the distance of several feet. Having

deposited the burden, he will march back and join the female. Before quitting the subject of ravages of the Lamellicorn Beetles as observed by me, I will here introduce a remarkable circumstance connected with the history of these insects observed some years ago, and which may be of some interest to a few.

It was observed in the Government Tea Plantation in the Dehra Dhoon that a small beetle—one of the *melolonthidae* I should think—was injurious to the plantation. These creatures, to the number of a dozen or twenty, lay concealed, buried in the ground underneath the bush to the depth of two to three inches during the day, coming out at night-time and feeding upon the leaves of the plant. Their ravages became so alarming that the Superintendent, Dr. William Jameson, directed immediate extermination of the pests. This was effected as follows:—A party was told off. Each man with a hoe and small basket turning the earth up around the plant exposed the beetles, which were collected and thrown into the basket. Twice a day these baskets used to be brought to the Overseer's quarters, who destroyed the beetles by pouring scalding water over them. By systematic perseverance bushels of these beetles were gathered and destroyed thus, and eventually the plantation was freed of them.

28. *Weevils*.—Rhyncophora are extremely injurious to vegetables, both as limiting their reproduction and also by boring into the young stems of plants and living upon their juices. They also (the curculios) injure felled timber by boring into it.

I have figured two varieties of the latter in Plate VIII., F. 1 and 2, 3, 4, 5. The larger of the two were obtained from a log of *Butea frondosa* (Dhak). These insects had bored circular holes vertically into the log of about, the largest one, one inch in diameter, and to the depth of seven or eight inches. They congregated in small colonies scattered over the log, a dozen or fifteen together.

The log from which I obtained the specimens had no bark on it, and the perfect insects had apparently bored into it

because it was food suitable for them. I can imagine no other purpose, as, though I examined a large number of the holes, I could discover no other object for which they were made. I may mention that each hole was occupied by a single

* Further observation has proved these *curculio* to have been bred in the wood. I recently obtained specimens in all stages of growth.—R. T.

individual *curculio*, and that by both males and females respectively. *

The smaller weevils figured are those common to the alpine regions. These insects are found inhabiting similarly the timber of *Pinus longifolia*.

They are not very common, nor have I been able to detect their ravages to any great extent.

Of the smaller weevils which I have not been able to figure, owing to their minute sizes, are *Bruchus* and *Rhyndachites*. Their ravages are of the highest detriment to the reproductiveness of our forests. I have reported before in my letter No. 63, dated 1st September, 1866, that entire seed crops of the *Vatica robusta* were destroyed in 1863, and that partial destruction of them was observed since.

During May and June of this year, I was enabled to devote some considerable time in observing the ravages committed by these insects. Their mode of attack is that common to the whole family, *viz.*, the insertion of the eggs in the stigma of the flower, which, when developed, has introduced the young larvæ, which are hatched meanwhile into the recently formed fruit or pericarp. In this the larvæ live till nearly mature, when, by their encroachments towards the peduncle or stalk, cause the fruit or seed to fall, and thus serve a purpose they have in view of making their escape into the earth to undergo the transformation into the *pupa* state. Before the seeds can have been perfectly ripe, they are thus caused to fall to destruction. On the 22nd, 23rd and 24th of May of this year, my brother and myself had opportunities of examining the seed-pods of a considerable number of trees, and by dissecting them to discover the larvæ, which were invariably from three to four in each seed. Travelling as we



were then, through the forests, it was impossible to have reared the grubs to perfect insects.

As a familiar type of the genus known as *Bruchus*, the common gram beetle furnishes a good illustration. The insects of this genus attack most leguminous seed-pods: peas,

* These insects live in the seed till their perfect development, when they escape by making an oval or circular orifice. This may be familiarly seen in gram and peas which have been subjected to their attacks.—R. T.

beans, gram, &c., furnish familiar examples of such.* A longish weevil, which

will be found figured in Plate X., f. 1, 2, was constantly found present underneath the bark of felled logs. It appears to me to be a *Lixus*, one of the divisions into which the *Longirostres* have been made, and has the power to bore through the softer parts of wood with facility. I did not observe its *larvæ* or *pupæ*.

29. *Xylophagi* or wood-eaters, by which name is known an extensively numerous family of timber-affecting insects, common everywhere, and which from the peculiarity of their living inside the wood even in their perfect state, and their usually minute size, render them not only difficult of eradication, but also causes the timber attacked by them to become perfectly unsound.

To the natives they are known as the *Ghoon*. I do not

*I believe this to be a species of *Tomicus*, a minute cylindrical species I have observed boring into beer and water casks; as they bore clean through the wood, the liquor may be seen jutting out at various points, and by the force of the discharge the little borers are thrown out with it.—R. T.

know of any except one species that will attack the harder descriptions of wood, viz., the heart wood

of the common oak, *Quercus incana*. This is an alpine species, and affects felled oak timber in large numbers.*

As a rule, however, the wood-eaters confine their attacks to the immature or sap-wood, and in that case are frequently found in great numbers in the white wood of the *Sal*.

In the Dehra Dhoon I have known poles and rafters, formed of a single stem of a young *Sal* tree, and consequently immature wood, so entirely eaten as to cause the roofs of the buildings in which they were used as supports to fall in. It

is not more than three years ago, a similar occurrence was noted by me, of a large native building in one of the towns of the hills, and in which the Cheer or *Pinus longifolia* wood was used, falling in, the beams of which had been so eaten that, with exception of just an outer shell, the whole solid portion of the timber was destroyed. I can report this not from hearsay, but from actual inspection and personal enquiries into the cause of the damage. The insect which did it all, and specimens of which I have procured, is one similar in characters and habits to the *Hylesinus piniperda* of European Forests. A well-known individual of that genus is recorded as being extremely destructive to the Elm trees around London. The *Ghoons* are undoubtedly of—I may make use of the term in this case—omnivorous habits; nothing comes amiss to them,—bamboos, dried drugs, cheroots, paste-board, books, and even furniture made up of any light description of wood, although painted and in daily use, will be attacked and eaten by them. It is no uncommon thing to meet with Bareilly and Delhi-made chairs, elaborately painted over, so perfectly unsafe from the attacks of the *Ghoon* as to seriously jeopardise the users of them.

The individuals figured in Plate VIII., f. 6, 14, and 15, are of the genus *Bostrichus*; they affect chiefly the dead woods of forest trees, which they perforate so as to render the parts perfectly useless for anything except fuel. The *Bostriichidæ* are the largest beetles of the whole of this family, and may always be known by the *vertex* of the head forming a kind of hood projecting forwards.

Others, such as belong to the Genera *Scolytus*, *Hylesinus* and *Tomicus*, are of smaller size, but more numerous and common in individual numbers than the former section. The *Tomici* chiefly affect bamboos, and are very destructive to them. The *Hylesini* also attack the bamboo, but not so vigorously as their smaller brethren the *Tomici*. Detection, however, of the ravages of either in any case when the objects attacked can be examined, is by the powdery excremented particles which they and their larvæ throw out. Mr. R. M.

Edwards describes their mode of attack accurately, but erroneously refers them to a species of white-ant.

Common Pine—Vernacular Cheer—is attacked when felled and left in the forests by a beetle of the genus *Hylesinus*; I have now a plank which is bored to the depth of eleven inches by this little insect. It attacks in vast numbers, and the larvæ, when hatched underneath the bark, bore in all directions, the tendency being, however, always to reach the centre of the log; the circular holes, barely one-tenth of an inch in diameter, may be counted by hundreds on a square foot of surface.

This *Hylesinus* apparently does not attack living trees, nor logs which have had the bark stripped off at the time of being felled, but such only as have it left on and are allowed to lie in the forest.

It would be well if officers having occasion to employ the *Cheer* wood for building purposes were made aware of these facts,—it would save much of their timber being rendered useless for beams, posts, and even planks.

The plan usually adopted by the natives for destroying the *Ghoon* is by immersing the affected articles in water, leaving them there for a considerable time,—at least a month or fortnight. I know it is the plan pursued by all traders in bamboos, as the *Ghoon* is very partial to such stock.

I have also known tar or paint applied to the infected wood as a means of destroying or driving them away, but with no success whatever. A little reflection will, however, betray to us the ineffectiveness of such measures, as the insects do not attack the outer surfaces, but burrow interiorly in various ramifications, crossing one another until the whole solid portion of the wood has been devoured. They leave the outer shell intact, and only betray their presence by little circular holes which are admitted for air and ejection of excrement. That the admittance of air is one of the purposes served by these holes will be evident on closing the orifice with the finger, which will immediately cause the insect to come forward and press against it. This operation is, however, always performed backwards by the insect.

Reference is made to the ravages of these insects in correspondence printed in Circular No. 3, dated 3rd January, 1867, joint report by Messrs. Carter and Wilkinson of Madras Railway, dated 23rd February, 1866, under Fabricius name of *Apate*.

Both *Tomicus* and *Bostrichus* are, however, of habits similar to those reported, and I have no doubt that they will be found identical. They appear to be largely distributed over the whole continent of India, and the woods attacked by them and named by those gentlemen in their joint report correspond exactly with the known habits of these insects.

Saw-flies.—*Tenthredo* and their pseudo-caterpillars never attack wood, though the perfect insects are known to lay their eggs in the bark of trees. The caterpillars when hatched never bore into the wood, but live entirely on leaves.

It is further interesting to know that even a strong impregnation of the sulphate of copper had not the effect of preventing the *Ghoon* from attacking the sleepers so experimented on, and rather goes to strengthen the known facts of the habits of those animals referred to in a preceding page, and also proves the extraordinary circumstances under which they can be developed.

The fact of their being killed, however, on the sleepers being buried, also strengthens what has already been adduced as to the method usually resorted to by natives when they wish to rid themselves of these annoyances, by immersing the infected articles in water. Deprivation of air, no doubt, is the cause of death in either case.

The white or sap-wood of any description of timber, except that of Huldoo, *Nauclea cordifolia*, as far as my experiences go, is the only portion attacked by the *Ghoon*. However, spongy or soft woods, whether mature or otherwise, are attacked and indiscriminately devoured by them.

30. We have come to the fifth division of timber-destroying insects—a section which I hold only second to the preceding for its destructive habits.

The Longicornes are a highly diversified family of beetles; they are numerous in individuals under certain circumstances

only. They may be said to be the bolder pioneers, created by eternal wisdom for the dispersion of dead vegetable matter, and also of bringing to a speedy termination the existence of such trees as have lost all physical attributes, and which are no longer necessary within the sphere of action for which they were created. The Prionii, among the head of this class, form a remarkable group. Their larvæ, as a slight distinction, are frequently found inhabiting plants of an alpine region, and of harder stems than of those of lower altitudes.

A remarkable *larva*—for this reason, that some attention has been paid to its habits—attacks the tea plant, and which, from the specimens I have procured, and from whose habits I can form some knowledge of its characters, I believe belongs to this family. I have not been able to rear this insect to the perfect state, but I have no doubt as to its position in the natural history of its tribe.

The way in which the larva is originally introduced into the main stem of the tea plant is by the punctures of the mother beetle. An incision is made at the root of the plant, the egg is deposited, and the larva as soon as it is hatched forthwith begins to bore into the pith of the stem; having arrived there, it either begins to hollow out the stem in its course upwards, or descends, while young, downwards to the tap root; and from there eventually taking the upward course, it hollows out for itself a tunnel capacious, yet at the same time most injurious to the plant it has fixed upon for its sustenance and habitation.

The plant sooner or later is destroyed, while the larva lies at its roots undergoing the *pupa* state. I do not know of any way of destroying these pests without killing the plant, which in any case is sure to die, sooner or later, under the operations of the insect. My observations on the habits of Capricorns, both Prionidæ and Cerambycidæ, such as attack living trees, tend to the conclusion that they invariably fix upon plants whose flow of healthy sap has been interrupted by some cause or other; very frequently the injury sustained by

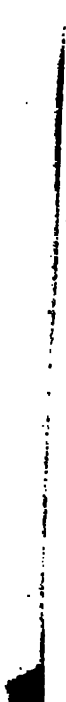
the stems of tea plants may be directly traced to the coolies carelessly wounding them during the process of hoeing. Fires, I feel confident, in the case of our forest trees, directly tend to prepare them for the reception and nourishment of insects.

The *Sal*, or *Vatica-robusta*, is attacked by beetles, *Cerambyx vatica*, figured in Plate IX., f. 3 and 4, 5, 6 ; though poor specimens, they convey an accurate description. The insects of this tribe grow to a greater size, and are consequently of greater injury to the timber attacked by them.

In its healthy and vigorous state, the stem of the *Sal* is apparently never attacked by any description of insect, but no sooner has the flow of healthy sap ceased than a host of young larvæ are hatched, the produce of the *Cerambyx vatica*—a name which I have distinguished it by from the peculiarity of the insect being always found on the *vatica*. This *Cerambyx* never attacks the timber when the bark has been removed, and it is only after the tree has been killed and the bark allowed to remain that it is resorted to by the beetles for the purpose of breeding. The experiences and observations of seven years I can offer as satisfactory evidence for the truth of these assertions.

One is sometimes, however, struck on seeing an apparently healthy tree bearing the appearance of harboring these insects from the excremented powdery saw-dust-looking particles, which is the sure indication of their presence within the timber. On closer examination it will be observed that the abode of the larvæ is confined to certain space on or around the trunk, and further investigation will invariably prove that portion to be either diseased or injured in some way or other ; so that a diversion of the sap had occurred, partial decay had set in, and thus prepared the apparently healthy trunk for the reception of the insects.

During the whole of my experiences, extending as they do to all the forests of Kumaon and Gurhwal, from the Sarda to the Ganges, I have never, during the whole course, found any other description of beetle, except the little *Buprestis* previously reported attacking *Sal* wood. The larvæ of both



the Cerambycidæ and Buprestidæ can easily be destroyed when within the timber by either pouring scalding water into their holes, or by immersing the logs in a tank or in a stream of water for a couple of days. In either case the soft-bodied grubs, which the pricking of a pin is able to kill, will surely be destroyed.

Extremes of temperature are also unfavourable to their perfect development. Hot dry winds or a too great humidity are conditions which affect them considerably. Frequently have I left a colony in a log of felled timber, hoping on my next return to find my little friends well and hearty; but, alas! for well developed pupæ, I have found nothing but dry skins—the little animals having evidently all perished from the dry hot winds then prevailing.

In other instances, instead of healthy grubs, I have found them dead and mouldering from a too great humidity.

From a series of observations, I have been able to arrive at the following conclusions as to the conditions necessary for their development:—

1st,—A peculiar first condition of the timber is necessary, *viz.*, partial decay, decomposition commencing in the immature portions of wood.

2nd,—Bark remaining, as essential to the reception of the eggs, and consequent protection and nourishment of the young larvæ.

3rd,—Their ultimate growth and maturity dependent on the state of the wood being of a moderate freshness.

If, by undue exposure or other cause, the affected timber becomes too dry, the grubs, if very young, die, as they are unable to subsist upon material which they cannot triturate; if grown of a considerable size, say from $\frac{1}{2}$ to $\frac{3}{4}$ inch in length, they will at once avoid this state by boring directly towards the centre of the log in search of a more moist residence. Here, having to subsist upon less nourishing matter than is found immediately beneath the bark, their consequent development is meagre, and the produced insects are barely one-half the size of those reared under more favorable circumstances.

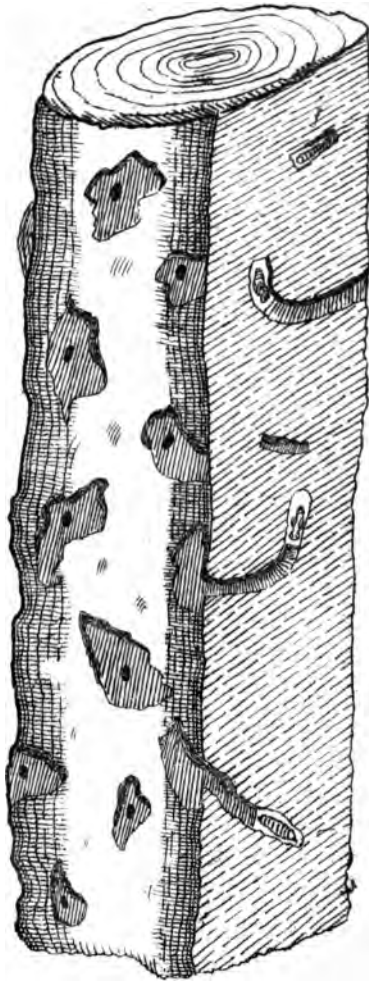
In their larva state these insects are open to the attacks of both the Ichneumons and Acari, both parasitical insects, the larvæ of which feed upon the young grubs.

From these conclusions it will be evident that, although we cannot well avoid the first condition necessary to the development of such timber-destroying insects, yet it remains with us in a great measure to treat our felled timber so that the second necessary state cannot exist—viz., by removal of the bark from the wood before it can have been operated on by the parent insect.

And lastly, though we failed in carrying out the barking of our logs at the time of felling them, it is nevertheless proved to demonstration that the grubs can easily be destroyed by means recorded in previous paragraphs.

The views entered into regarding both the propagation and destruction of the larvæ of one or more species of the capricorn beetles, and which obtain commonly the name of *Mukora*, in the vernacular by Mr. R. M. Edwards, Collector and Magistrate of Bareilly, published in the *Government Gazette* of the 20th March, 1867, are obviously erroneous, but the opinions of the Pillibheet timber-merchants are decidedly correct.

The inference drawn from the fact adduced of a piano having a living insect operating in some of its wood-work goes to prove nothing beyond that either one of the numerous tribes of hymenopterous insects commonly known as carpenter bees had availed itself of the soft wood of the framework to burrow for its coming progeny a comfortable breeding place, and during this operation betrayed itself by the grating noise referred to ; or what is equally probable, the piano which is stated as having been imported from Stuttgart, in Germany, in 1862, and the occurrence as noted by Mr. Edwards, dated back two years from the time of his writing, was nothing but a *Buprestis* imported from its native forest in the wood which made up a part of the instrument. In that case the specimen was worthy of being secured and preserved, as going to prove authentically one of the habits of a portion of beetles comprising the section *Buprestidæ*,



BORINGS OF CERAMBYX VATICA.

and which are known to exist in timber for a number of years before turning out the perfect insect.

There cannot be a doubt that of the four kinds of *Mukora* referred to by Mr. Edwards, not belonging to one or more species of *Cerambyx*, in their different stages of growth, form and color are often found questionable guides in the case of identifying larvæ that have fed on different kinds of wood : as a rule it may safely be laid down that each species has its own peculiar food, upon which alone it lives ; but frequently as often the same insect may be found of various shades of color, size, and appearance in different specimens of the same wood. These differences will arise from the color, density, and other conditions of the wood, which the insect, by partaking of it as food, and adapting itself to it as its abode, conforms to the state in which it lives.

That success seldom followed the use of oil of turpentine injections can easily be imagined, as most of the woods upon which the larvæ of the *Cerambyx* beetles live are more or less impregnated with it in their natural state.

As familiar instances, the mango and pine may be adduced, and which are both inhabited by grubs of those beetles.

31. There is yet another form in which our Sal Forests are liable to suffer from the attacks of their insect foes.

Before the saplings can have arrived to hardihood sufficient to overcome the undergrowth and fires consequent on such rubbish, it is attacked, and in some localities to a very great extent, by the larvæ of a species of *Cerambyx*. I have not yet been able to breed the perfect insect, so as to identify it.

The operation commences precisely as in the case of the grub of the *Prionus* on the tea plant. It first bores downwards and then up, destroying the pith, and eating for itself a round tunnel extending from the root to the highest point the insect can reach up the stem without disclosing its retreat. The plant is killed.

Trees affected by this insect may be known by the little heaps of saw-dust-looking excrement collected at their roots, ejected through an aperture made on purpose by the insect.

In the Forest of Chounturreeah, to the east of Dhikolee, my brother and myself examined scores of young trees during May last, and which were all indicated as being affected by the worm by the peculiarity pointed out. The color of this grub is a fleshy white, slightly pinkish when held up and looked at through the light. It is usually those we collected, and which appeared not to be full grown, about two inches in length, and, as usual, armed with a pair of powerful mandibles. Toon and Sissoo are both attacked by a larger and more powerful *Cerambyx* than the one found on Sal.

Their origin and development are precisely similar with the others already reported.

A minute species, however, attacks the living bark of the *Acacia catechu* (Khair) and these may be detected always by the gummy exudation their presence within the tree causes. The injury they cause is not very slight, as they get underneath the bark, and by eating away the newly-formed wood, they considerably derange the health of the tree.

A small *Leptura* which I have figured (Plate IX., f. 13) I found sometimes in considerable numbers in our harder woods, and one or two logs which I split up and examined were found so thoroughly bored that a large flat bit of about a foot in width resembled a sieve with the numerous holes with which it was pierced.

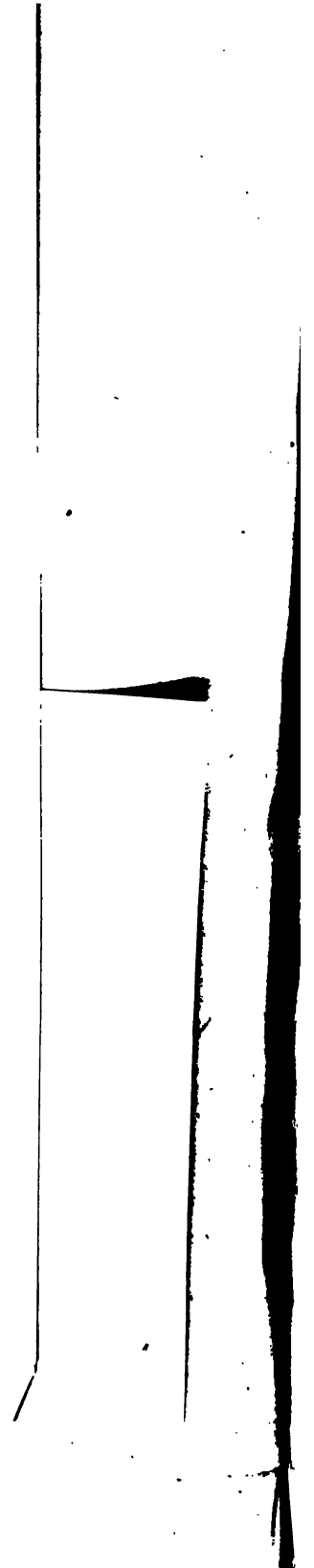
The *Saperda* have also their representatives in these forests; specimens I have figured Plate IX., f. 16 and 17.

Two large *Lepturæ*, with *larvæ* and *pupæ*, are also figured in the same plate. They were obtained from the Goug creeper (*Robinia*).

32. *Rottleria Tinctoria*. *Rewneah*, from which the vermifuge and dye known as *kamilla* is procured, is constantly the habitation of another *Cerambyx*, whose *larvæ* bore in various directions through the living trunk of the tree.

I procured one with much difficulty after felling the tree, and then consecutively tracing it up from the root to about four and half feet in the stem. This larva was over four inches in length, and as thick as a man's thumb. I also

in the season as November.—R. T.



observed that a very large proportion of the Rewneah trees that I subsequently met bore the appearance of being infected with this grub. Seemul, *Bombax heptaphyllum*, Soongna, *Moringa pterygosperma*, and the Roongra, *Erythina Suberosa*, are attacked by a magnificent beetle, the *Monochamus Soongna*, one of the tribe of Cerambycidæ. The larvæ of this insect, which are extremely large, and armed with powerful mandibles, are very destructive to the woods I have described. The injury they cause is truly surprising, and within so short a space of time, their rapidity and extent of operations being considerably greater than any other form that I have met with. Out of a log of *Soongna*, I have collected forty-three perfect beetles, about a dozen larvæ, and five or six pupæ:—the log was not above six feet in length and about thirty inches in girth. I have figured three stages of this insect in Plates V. and VI.

The Wild Willow, *Salix tetrasperma*, is also attacked in a living state by another *Monochamus* beetle, which enters the trunk, and bores through it in all directions, ejecting the triturated particles through holes made for the purpose. I have figured both the ravages of this insect and its larva and imago in Plate VII.

A third *Monochamus* beetle was found under circumstances of extraordinary development. The pupæ were discovered in solid cocoons made of a substance resembling lime. The shell was fully the sixteenth of an inch in thickness, quite hard and firm, offering in fact more resistance to the pressure of the fingers than would a pigeon's egg.

They were discovered underneath the bark, imbedded between it and the wood in a felled tree of the *Butea frondosa*, or Dhak. The larvæ had apparently only lived on the sapwood, and underwent the second metamorphosis on the site of their original operations; another remarkable fact was that these beetles are in the perfect state as early as March.* I have figured two of them in Plate IX., f. 1, 2.

* I have since obtained numerous specimens of these beetles and their cocoons, imbedded to the depth of eight inches in logs of *Odina Wodier*, and *Bombax Heptaphyllum*. They are the commonest and earliest variety of the *Monochami* out. The perfect insects having been obtained as early in the season as November.—R. T.

33. *Ravages of Hemipterous Insects.*—The term hemiptera is also compounded of two Greek words signifying half wing,—a circumstance found in this order of insects. The term is applied because of the first or upper pair of wings being stiff and corneous at the base and membraneous at the end. The second pair of wings is membraneous throughout.

They do not undergo a complete metamorphosis, being hatched from eggs, the larvæ and pupæ remain much alike, both retaining the power of locomotion and capacity for eating. They differ from the perfect insects by not having wings, and by also being smaller. Their fecundity is enormous as compared with other orders of insects. The common house-bug and all the aphides or plant lice might be accepted as examples of such.

The usual mode of propagation is by eggs laid by the parent insect, but sometimes, under pressure of conditions unfavorable, they will produce living young ones.

It is also stated of plant lice that a single impregnation of the female by the male is sufficient for her to go on producing several broods during the season without further connection; and that the progeny thus born are capable of carrying on the productive capacity without the aid of males—the one impregnation of the original mother being sufficient for herself and progeny for ever after. The proportion of males, therefore, in this family is exceedingly limited.

The Hemiptera may also be known by the absence of all manducatory organs; they have instead a long sharp-pointed trunk, with which they pierce vegetable and animal substances, and live by suction on their juices; they are therefore highly destructive, as by piercing the organs of plants they utterly destroy them. Their trunk is always carried placed horizontally on the breast. Their eyes are prominent at the extremity of the small head; a few have in addition two ocelli or spurious eyes. The trunk is an organ which can pierce the hardest substances—for instance, cherry and peach-stones, and also the stones of other fruits. The hard shell is pierced and the juices of the kernel sucked up. Instances are not rare in the Kumaon Forests where a large and magnificent (two inches in length, the females) red bug is found;

these may be observed sucking the stones of the *Lussora* or *Cordia Myxa*. It will therefore be understood why these insects are reckoned destructive to vegetable life. By piercing the soft stems of young plants they cause thousands to perish in the course of a single day.

Bugs, both field and house, emit usually a disagreeable odour ; some are beautifully and brilliantly colored.

The class of insects known as Plant Lice, or *Aphides*, are injurious to young shoots and twigs when infecting in large numbers. In this development they are sometimes met with in our forests.

A very pretty one is that found on the Dabree tree ; it will be known by its clustering round the stem in large numbers, conspicuous for the white downy appearance, which the long filimentary processes issuing from its body give it. Some of these pretty little creatures will remind one of a porcupine with all its quills bristling. They excrete a white substance of a sweet taste, and which cakes on the leaves of the plant they affect.

Another *Aphis*, but without the filimentary process, is found on the Sal, and in some seasons they are excessively numerous, dropping their sweet, honey-looking excrement on the leaves, stones, and the ground beneath the trees they live on.

34. Lac, Shell-Lac, or crude substance known under that name in the bazaars is the habitation of the *pupa* of the *Coccus lacca*, chiefly inhabiting Dhak and several species of *Ficus*, also other trees.

These scab insects are excessively numerous wherever they may be found to have taken up their abode.

I have known trees to perish entirely from exhaustion, the result of the millions of punctures into their tender shoots rendered by a colony of these insects. The produce, however, of their labors is a source of much value to the country.

Cochineal is another article of much importance, the produce of this family.

The Cactus, or Prickly Pear, is at certain seasons so attacked by them that in a country where the pear was a nuisance, in a short space of time not one was left.

In June last I observed that the *Coccus opunti* had began its attacks on the Cacti growing in the valley of the Kossee River above Ramnugger.

It will be well if the fact reported above be followed out by further observation, as to whether these insects really exterminate the plants they fix upon.

35. *Ravages of Neuropterous Insects*.—This term likewise is derived from the Greek language, forming a compound of nerve and wing—nerved-winged. These organs, four in number, of nearly equal size, are always membranous and finely reticulated, giving the appearance of fine lace.

Familiar examples are the dragon flies, and flies, mosquitoes, and winged white-ants. They are produced from the eggs to larvæ, which are very active, and provided with six legs; manducatory organs, viz., both maxillæ and mandibles. Their *pupa* state is either complete metamorphosis or only a semi-change.

The perfect insects are either carnivorous or herbivorous in their habits, are provided with strongly-developed masticatory organs, and are very active in the pursuit of food.

The white-ants, *plani pennæ*, construct large and elaborate nests, and their fecundity is enormous. They, with the bees, feed up a female to enormous gravidity; this impregnated female is the queen of the nest, and founder of new colonies.

The perfect insects are devoid of stings; have two compound eyes, and two or three ocelli; two pairs of membranous wings; six legs, and antennæ, which are setaceous simple.

Terme, or white-ants, as they are usually called, are, like the bees, divided into three classes—males, females, and neuters. The latter defend the nests from intrusion, and can inflict a severe bite.

White-ants work in large societies, excavating galleries and chambers, not only in the earth, but also into solid timbers

and up along the bark of living trees. They are very destructive and injurious to both vegetable and animal substances.

White-ants, — Termites.—Much has been written upon these insects and the extent of their injuries, but apparently no method has been discovered to keep out their ravages. I know of no method calculated to exterminate them ; sufficient that in timber yards it is customary to strew wood-ashes underneath before the wood is stacked.

Huldoos timber is very slightly attacked by them, from apparently a bitter principle found in this wood.

Fresh Huldoos will not be touched by them under any circumstance, and it is then that the juices of the wood are fresh ; but on drying and the bitter principle being changed in its chemical properties by dessication, the wood will be attacked. In Kumaon and Gurhwal our timber-yards are comparatively free from these destroyers,—in fact, we are never made aware of their ugly ravages by being brought in contact with them.

In our forests they seem to prefer other substances, which are abundant, to the harder timber of the Sal.

36. Saw-flies, *Tenthredo*, do comparatively little damage. They do not bore into timber, and their larvæ are never so numerous as to endanger the plants whose leaves they feed upon.

37. Gall-producing insects, *Cynips*, are numerous and of great variety in our forests. They form, by puncturing and laying their eggs in large numbers in the fruits, seeds, and leaves of plants, those excrescences known as galls.

A common species affects the oak on these hills.

38. The tribe of Hymenopterous insects is very much diversified. They have complete metamorphosis—four wings ; membranous, but not reticulated, as in the Neuropterous order. The anterior pair is always largest. Have two compound eyes, and three simple ocelli placed on the vertex of the head ; six legs in the perfect insect ; and are provided with jaws, both mandibles and maxillæ ; antennæ, either setaceous or many-jointed, of various shapes ; are produced from eggs,

larvæ usually vermiform, without legs ;—a few have these appendages of locomotion, however.

Familiar examples of Hymenopterous insects are bees, black ants, and flies.

Many live in societies, and are divided into three classes,—males, females, and neuters. Their labors and régime are the theme of continual admiration.

The larvæ live upon various substances ; some are carnivorous, others herbivorous. The perfect insects, however, live chiefly upon flowers and honey ; a few are carnivorous and omnivorous—for example, black ants.

Many feed their larva upon the fecundating farnia of flowers and honey. This compound food is deposited in the cell with the egg. The young is hatched and feeds upon the provision thus laid up for it, which is so nicely adjusted that the larva has just arrived at maturity when the food is exhausted.

The genus *Xylocopa* furnishes familiar examples of the above.

The term Hymenoptera is compounded of two Greek words, signifying skin or membrane and wing.

Carpenter Bees,—*Xylocopa*.—These bore tunnels in timber, where they collect honey and the farina of flowers, leaving a lump of this compound in a divided cell for the nourishment of the young larva when it is hatched. Each cell has with the egg a separate supply of this food. The larvæ are hatched subcylindrical whitish worms, the anterior and posterior terminations becoming considerably thinner than the body. They have no legs, or if, only rudimentary. They undergo the pupa state within their respective cells, and come out the perfect bee after a brief period.

In these forests there are three varieties of the *Xylocopa*.* The largest one known to the natives as the Bhoura, *Xylocopa purpurea*, is a remarkably strong-flighted, active insect. It is very destructive to wood-works of buildings, and also to the dead wood of forest trees.

* See Plate X. for figures of these insects.



The second, or brown *Bhoura*, I procured from a tree in the Forest, *Ficus Glomerata* (Gooler).—It is a large variety of the Carpenter Bee, and I would call it for distinction's sake *Xylocopa Fici*.

This insect bores a three-chambered tunnel, and each chamber has two cells. It lives in colonies, and is a social bee.

I procured both larvæ and pupæ of this insect, but unfortunately before I could have them figured they got destroyed.

The third variety, or lesser *Bhoura*, is very common, and lives in social gangs. It burrows with much energy, and is more destructive on that and on account of its social habits. Large beams and thick trunks of Huldoo are bored excessively, so as to render them perfectly useless for any purpose except firewood.

The *Xylocopii* may be caused to shift their quarters by application of liquid resin (beerja or tar). The wood smeared over with either they will never attack, and even fixed habitations they will forsake if the noxious tar be applied so as to enter their holes to some extent.

39. Having recorded all that has appeared to me as being required to be furnished in this Report, I beg to add that if it be the wish of Government that this interesting subject be still further investigated, that I am both willing to undertake the prosecution of it on more scientific grounds than I have been able hitherto, and also to illustrate the insects and their ravages, besides collecting notes on their natural habits, which may ultimately be useful to the Forest Department of India.

PLATE I.



..CANUS CERVUS: MALE.





PLATE IV.



PRIONUS CINAMOMEUS: MALE, FEMALE, AND LARVA.

MONOCHAMUS SOONGWA: LARVA AND PUPÆ (UPPER AND UNDER SIDES);





2a2b
Photo



MONOCHAMUS SOONGNA: LARVA AND PUPAE (UPPER AND UNDER SIDES).



FIG. 1, 2. *MONOCHAMUS*, SP. FROM *BUTEA FRONDOSA*. FIG. 11. *LEPTURA* FROM *DALBERGIA*
 " 3, 4. *LEPTURA* FROM *ROBINIA MACROPHYLLA*. " 12. *SAPERDA* FROM PINE
 " 5, 6, 7, 8. " LARVÆ AND PUPÆ

PLATE VIII.

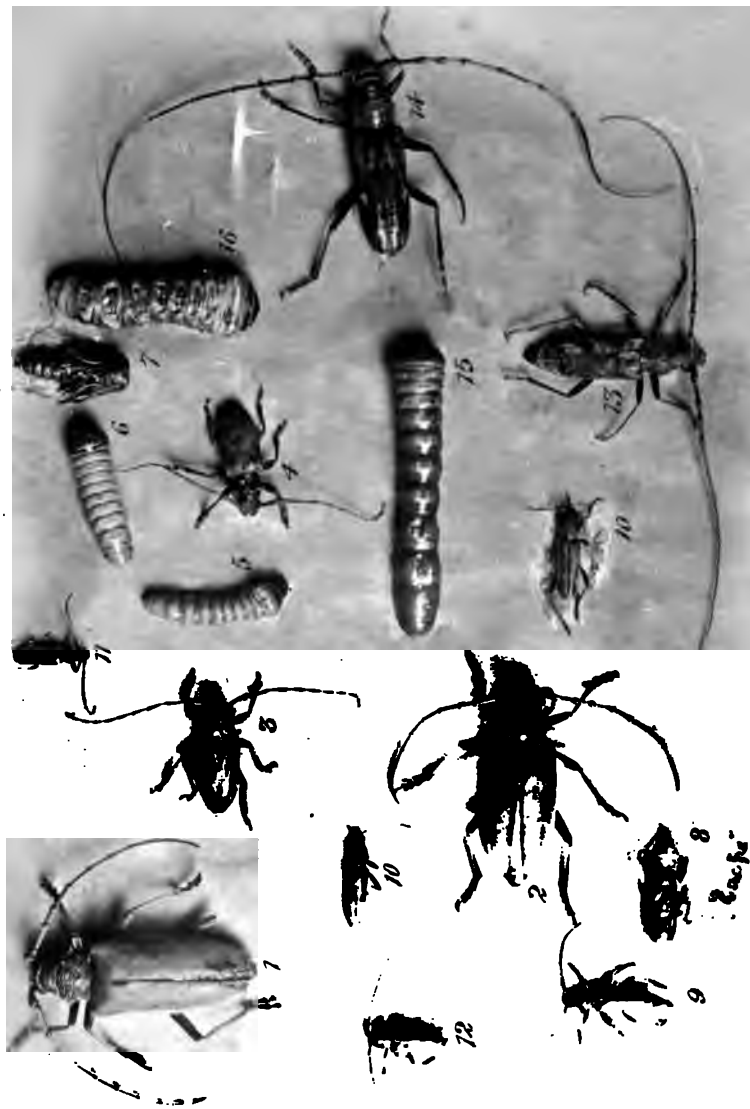


FIG. 1, 2. *MONOCHAMUS*, SP. FROM BUTEA FRONDOSA. FIG. 11. *ESTIDA* FROM PALMERA.

PLATE IX.

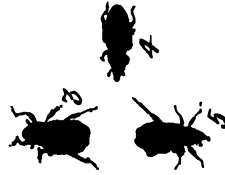


FIG. 1, 2. CURCULIO FROM LOG OF BUTEA FRONDOSA.
 " 3, 4, 5. " " PINUS LONGIFOLIA.

FIG. 15. BUPRESTIS FROM ACACIA CATECHU.
 " 16. " " LARVA.



2.2.1. Photo



FIG. 1, 1. XYLOCOPA PURPUREA.
 2, 2. " SPECIES FROM NAUCLEA GORDIFOLIA.
 FIG. 3, 3. XYLOCOPA FIGEL.
 " 4, 4. CURCULIS (LIXUS) FROM VATICA ROBUSTA.



